Gouvernement du Canada
Ministère des Communications

Government of Canada
Department of Communications

Le Centre canadien de recherche sur l'informatisation du travail
Canadian Workplace Automation Research Centre

Canada

Communications Canada
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A STUDY OF ATLANTIC CANADIAN USER REACTIONS TO INTER-UNIVERSITY ELECTRONIC NETWORKS

Summary Report

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February 1987

This report, is one of a series of research papers that are result of work done by or for the Organizational Research Directorate, Canadian Workplace Automation Research Centre, Department of Communications, Government of Canada. This views expressed in this report are those of the authors.

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90-02851/

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Cat. No. Co 28-1/6-1988-E

ISBN 0-662-16186-6

TABLE OF CONTENTS

Acknowledgements i

Executive Summary ii

INTRODUCTION 1
- Context of the Study 1
- The Networks 2
- Questions the Study Sought to Answer 4
- What the Study did not Measure 5
- Approach to the Study 5
- Participants 6
- Training 6

RESEARCH 8
- Design 8
- Data Collection 11
- Data Analysis 13

FINDINGS 14
- Expected and Actual Use of the Networks 14
- Barriers to Network Use 16
- Motivators to Network Use 18
- Network Use and Work Habits 19
- Network Use and Peer Interactions 20
- Participants' Use of Features 21
- Cost of Network Use 22

CONCLUSIONS AND RECOMMENDATIONS 25

BIBLIOGRAPHY 29

i. Acknowledgements

The authors of this report are grateful to the many organizations, institutions and individuals who provided support during this study. The study was unique in that it was conducted from a variety of locations almost entirely by electronic means. The study's researcher, Geoffrey Gurd, monitored networks, collected data and performed analyses from his location at the Canadian Workplace Automation Research Centre in Laval, Quebec. The host computers which provided the network gateways were located at the Computer Science Department of Memorial University of Newfoundland in St. John's, and at the Computer Center of the University of New Brunswick in Fredericton. Administrative support was provided by the Office of Educational Communications of the Association of Atlantic Universities in Halifax, Nova Scotia, where the Director, Jocelyne Picot, acted as principal investigator. All of the participating institutions provided some hardware, software, network or human expertise in support of the study since participants used existing institutional equipment, and occasionally had to rely on assistance from their own computer centers in the course of accessing networks.

The following people and organizations were particularly helpful during the study and contributed to its success: Natalie Kischuk and Amyot Bachand (Canadian Workplace Automation Research Centre); Annabelle Stewart (Office of Educational Communications); Brenda Garagan (Association of Atlantic Universities); Jeff Sparkes and Larry Bouzane, Computer Science Department (Memorial University of Newfoundland); Bob Bodajla, Brian Lessor and Terry Arnold, Computer Center (University of New Brunswick); Michel Landry (Université de Moncton); Sylvie Lalonde (Dept. of Supply and Services); and the members of the Steering Committee.

The authors are very grateful to Christina Corkett who prepared the final copy from various sources and files and to Doris Lamontagne who created most of the figures.

The complete report with all tables, figures and unabridged text is available upon request. Please contact: The Canadian Workplace Automation Research Center, 1575 Chomedey Blvd., Laval, Quebec, H7V 2X2, Telephone: (514) 682-3400.

ii. Executive Summary

The present study was undertaken because a number of questions related to the use of large store-and-forward distributed mail networks needed to be addressed in order to plan future inter-institutional network development in Atlantic Canada. It was also felt that the study results might apply in similar contexts elsewhere. Though computer-mediated-communications and, consequently, network development is predicted to grow rapidly over the short-term, in Atlantic Canada as well as elsewhere, many user-related factors have yet to be examined.

First, it is uncertain if, how and why average users in post-secondary institutions will want to use large distributed mail networks. Secondly, as more users begin to access networks, their specific needs in terms of training, information, services and features need to be considered. Thirdly, as the number of nodes and networks are proliferating, more hardware, software and network options are becoming available to institutional computer centres and potential or actual network users. Thus it seems more urgent than ever to have user reactions documented systematically so that their needs can be taken into account in on-going and future network development. These needs could then be translated into desirable network features and services which should be implemented if networks are to answer potential user communication and information needs.

The study took place in Atlantic Canada, in 16 post-secondary institutions, under conditions thought to be typical of the conditions under which network users would work. That is, they would likely be forced to use existing hardware and software in their own institutions. In the course of the study, two networks were used: the Netnorth/Bitnet network and the CDNnet network. The Netnorth gateway at the University of New Brunswick and the EAN software at Memorial University's Computer Science Department were chosen as the entry points to the networks. At the outset of the study there were 61 study participants: faculty members, administrators and staff members of post-secondary institutions who have both teaching and administrative duties. Their computer experience ranged from neophyte to relatively experienced. The criteria for their selection was based on the following: (1) be interested in computer networking; (2) be full-time faculty or administrators or a combination; (3) have the necessary hardware and communications software readily available at their place of work; (4) have a reason or need to communicate with someone outside of their institution.

Over a period of eight months in 1986, the study sought to answer the following questions: (1) What is the usefulness of distributed electronic mail networks to academic and administrative users in the post-secondary institutions of Atlantic Canada? (2) What are the motivating factors and what are the barriers to network use? (3) Will use of networks change the work habits for users in post-secondary institutions? (4) Will use of networks alter the existing patterns of inter-organizational and intra-organizational communications between peers? (5) What will be the cost implications of using networks in the future, on a longer-term, routine basis? (6) Which network and electronic mail features should be recommended for post-secondary sector users in Atlantic Canada?

The research design chosen for this study is based on the framework provided by grounded theory research, which relies on data emerging from multiple sources to obtain answers to broad questions, such as those which are listed above. Two kinds of data were collected: quantitative data that measured the behavior of users on networks, and qualitative data that assessed user impressions towards using the networks. Quantitative computer-monitored data were gathered directly from the mainframe computers where study participants had accounts. Impressions were obtained from post-study interviews and three types of questionnaires: pre-study, on-line, and post-study. The report of the study contains twenty-four tables and seven figures showing the relevant data, plus examples of participant comments and responses to open-ended questionnaires.

The findings of the study were grouped under headings for use of networks, barriers and motivators to network use, network use and work habits, network use and interactions with peers, use of features, and finally, costs of networks. A range of information gathered through the means mentioned above is used to examine questions related to these topics.

The study found that the volume of network use did not change appreciably over the entire study period and did not match the participants' expectations. Participants were more optimistic about network usefulness at the beginning of the study than they were at the end. There were a number of barriers identified by the participants which are thought to have impeded increasing network use over the study's relatively short period: deficiencies in the quality and conceptual basis of the training, inadequate documentation and on-going technical assistance during the study, as well as a lack of a central directory of users anddifficulties in locating desired network services. Certain system features were also deterrents to network use, such as cumbersome on-line editors. Network use did not change participants' work habits.

In spite of the decreased level of network use over the study period, post-study interviews indicate participants would like to continue networking especially if improvements to the system are made. As well, during the study itself, important new network developments took place, including the implementation of gateways from one network to another, and an overall increase in network nodes in Atlantic Canada.

The "Conclusions and Recommendations" section provides twelve recommendations grouped under three different sets of conditions required for continuing growth and successful network use. Under the topic "assistance to users", it is recommended that a generic training package be developed for potential network users, which would include a manual, and an abridged list of commands. There should also be a 24-hour help line and an on-line tutorial self-help package. Under "network and electronic mail services", the recommendations are that users need clear information about directories of users and services, their location and their use. Users should be automatically registered in a directory unless the user indicates otherwise. Directions on how to access other networks should be provided to all users. Under the category of "user interface features", users require generally more transparent access to networks, simple-to-use editors and file-transfer software. As well, consideration is given in the recommendations, to the problem of equitable access to networks, a factor which must be taken into consideration for large-scale network development in Atlantic Canada.

A final section contains recommendations for future research.

1. INTRODUCTION

Context of the Study

Computer networking between and within academic and research institutions began in the early 1950s with the use of cable to link buildings and campuses or parts of institutions or affiliated institutions. Later, research and university libraries began to use computer networks for shared cataloguing, on-line search services, and computerized interlibrary loan services to distribute the enormous resources of scholarly information available in vast bibliographic data bases.

Technological developments also advanced the cause of networking rapidly in the last decade. New networks were created almost daily to meet the growing demand which has resulted in the researcher or administrator now having to access several networks to reach all the services needed. It was in response to this growth and proliferation of individual networks that distributed networks have appeared.

Many challenges are now facing computer centre directors and potential network users alike in reference to appropriate network use and distribution. These challenges relate to technological choices as well as to users' reactions, and since networks will only flourish with increased use, user needs in terms of training and network services are seen as important to the continuing successful development of networks.

The study was conducted amongst academics and administrators in post-secondary institutions in Atlantic Canada. All but one of the institutions in the study are members of the Association of Atlantic Universities (AAU), an association of twenty degree-granting institutions.

When this study began, development and implementation of distributed networks was just occurring in Atlantic Canada. Some guidance was expected to be provided by the Office of Educational Communications (OEC), an office set up originally to help AAU member-institutions to collaborate in the use of appropriate technologies for educational communications.

Other than the activity of writing the proposal, this entire study, except for three different on-site activities, was conducted by electronic communications. All communication, correspondence, planning, data collection, and administration were conducted by electronic-mail file transfer or by telephone, including two or three audioconferences.

The researcher was located in Laval, near Montreal, at the Canadian Workplace Automation Research Centre (CWARC). He was involved in the selection of participants by telephone, but the development and dissemination of the questionnaires, the data collection from the two sites in Atlantic Canada, and all analysis of the quantitative and qualitative data was done using computer-mediated communications.

The participants were located at 16 different institutions in nine different towns and cities spread out over the Atlantic Provinces. The technical support personnel were located at Memorial University and at the University of New Brunswick. They provided help to participants by telephone or via the networks. The administration and overall coordination of the study activities were conducted from the OEC in Halifax. Responses were sent electronically, occasionally by telephone or in writing.

The Networks

Quarterman and Hoskins (1986) have categorized five types of computer networks; research networks (for example, ARPAnet), company networks (for examle, IBM's VNET), cooperative networks (for example, Bitnet, UUCP), Metanetworks (for example, CSNET) and common carrier networks (for example, Datapac). A distributed network is a cooperative network administered by the community of its users. Some centralized control and organization may be provided, such as in the case of Netnorth/Bitnet. In other networks, less organization, user support and control is provided as is the case with CDNnet at this time.

The Netnorth/Bitnet network uses leased dedicated data communication linkages, essentially transparent to the user, to permit electronic communication, file transfer and access to a variety of services perhaps unavailable on the mainframe of the "home" university. Netnorth is the Canadian version of this network, and, at the time of writing, some 91 Canadian host computers were linked to 844 Bitnet host computers in the U.S. and 363 EARN host computers in Europe.

This network provides a store and forward service for message switching across a number of points (nodes). Between each of the points, a dedicated leased telephone line is usually used. For purposes of this study, communications traffic was monitored on a mainframe computer at the University of New Brunswick, which serves as an Atlantic Canada gateway to Netnorth and Bitnet.

CDNnet is a functioning x.400 network using a software product called EAN to link 65 host computers at institutions across Canada.

EAN uses a software process called Message Transfer Agent (MTA) to automatically and autonomously transfer messages from one computer to another. A message is delivered to a user by another process called User Agent (UA). The x.400 standard defines the protocols by which MTA's and UA's can communicate (Hart, 1986).

For the purpose of this study, a CDNnet node implemented at Memorial University of Newfoundland (MUN) served as a node in the CDNnet network, permitting user access to other nodes in regions across Canada through MUN. As with the Netnorth/Bitnet network, it was possible to communicate with other EAN sites across the world, as well as with other networks via gateways.

Though there are a number of reasons, one might speculate, why Atlantic Canadian educators, administrators and researchers in the post-secondary sector would require better access to computer-mediated communications, two in particular are of major interest. Preliminary assessments of the communication network infra-structure in Atlantic Canada show that, by comparison to other regions, there was, at the time of this study, less network development and consequently limited access to worldwide distributed networks.

The member institutions of the AAU share a number of informal and formal communication patterns and pathways. Taken together they have academic and communications needs roughly representative of all academic institutions in Canada. Yet, intra-regional long-distance telephone rates are higher within Atlantic Canada. This has resulted in Atlantic Canadians being at a disadvantage in terms of cost-effective, efficient and rapid communications intra-regionally. It has also been argued that Atlantic Canada presents unique communication needs. Located over 208,000 square miles of territory, with a population of 2.3 million people, the AAU institutions are physically remote from many large centres or sources of information. Thus it was anticipated that the rising communication needs of Atlantic Canadian academics, researchers and administrators could be partially met by distributed computer communication networks.

The study focussed principally on communications external to Atlantic Canada, since both networks used in the study were designed to provide access to institutions located in other parts of Canada and the world. As electronic communications to the world outside increase in volume, there is no doubt that intra-regional networking will undergo change and development. Indeed, it is hardly possible to consider intra-regional and extra-regional communications as separate entities. A future study might be centered on intra-regional communications more specifically.

Questions the Study Sought to Answer

The rapid development and proliferation of computer-mediated networks show great potential for linking individuals, interest groups and organizations, but it is uncertain how and why networks are used. It is also uncertain how useful networks are to both naive and experienced users. No one knows if and how access to networks changes the work patterns of academics, researchers and their administrators, and how organizational communications is affected.

The questions the study sought to answer can be summarized as follows:

(1) What is the usefulness of distributed electronic-mail networks to academic and administrative users in the post-secondary institutions of Atlantic Canada?

(2) What are the motivating factors and what are the barriers to network use?

(3) Will use of networks change the work habits for users in post-secondary institutions?

(4) Will use of networks alter the existing patterns of inter-organizational and intra-organizational communications between peers?

(5) What will be the cost implications of using networks?

(6) Which network and electronic mail features should be recommended for post-secondary sector users?

What the Study did not Measure

What the study did not examine is how well the networks performed in technical terms (speed, efficiency, fidelity and accuracy). The research examined the users perceptions of the networks' usefulness for transmitting information rather than any technical consideration of the transmission.

It was judged that protocol layers and levels of error detection would mean little to the network users since these processes are transparent to the user. What would be important however, would be to consider whether or not the message was sent and received reliably and what work place activities could be accomplished on a network, not the technical explanation as to how it was sent.

Approach to the Study

The use of computer-mediated communications and distributed networks by academic and administrative users in post-secondary institutions in Atlantic Canada was a relatively new practice when the study was initiated early in 1986. Prior to this, the OEC was established in 1984 to assist faculty members, researchers and administrators in AAU institutions to use communication technologies to enhance existing activities such as distance education and inter-institutional communications.

In documenting the growing number of inquiries and requests for computer-mediated communications and information in reference to networks, the OEC had accumulated a list of potential network users all located in Atlantic Canada. Since the networks used for the study were just being established it was uncertain how easily they could be accessed, how hard it would be to learn the software and what types of transactions could conveniently be conducted. It was therefore decided to use an approach to the study which would place heavy emphasis on the users' perceptions of their network use. This would be combined with computer-monitored data, showing network activity over the entire course of the study.

Participants

Over 300 people were contacted by telephone to find suitable subjects for the study. They were all members of faculty or administration in AAU institutions, and were affiliated to associations ideally representing a group of individuals with whom participants would wish to communicate. Participants were chosen for the study if they were thought to have met the following criteria:

1) be interested in computer networking;
2) be full-time faculty or administrators or a combination;
3) have the necessary hardware and communications software readily available at their place of work;
4) have a reason or need to communicate with someone outside of their institution.

When participants stated that they had a need to communicate with someone else, there was no reason to disbelieve them. However it became clear later on in the study that some people were not using or did not use the network very much or at all because they had no reason to communicate.

Participants were not randomly assigned to a network for several reasons. People already familiar with one system, were expected to use that same system. Certain universities were not connected to Netnorth and if they were, they would become another site where computer-monitored data would need to be collected. At most institutions, some participants were given access to Netnorth and others to CDNnet.

Sixty-one (61) subjects agreed to participate in the study. Of these, fifty-two (52) responded to the pre-use questionnaire. Forty-eight (48) of the respondents had a master or doctorate. The average age was forty-four (44). There were thirty-nine (39) males and thirteen (13) females. Eight (8) were engaged full-time in teaching activities, ten (10) in administration, one (1) in research, and the rest were engaged in a combination of these activities. Forty-two (42) reported not using any other networks and twenty-two (22) had never used electronic mail. Most had to share terminals or microcomputer equipment.

Training

The training was brief and concentrated on the commands necessary to enter the network, compose, send, receive messages, and log-off. Editing and searching directories were only briefly explained. As far as possible, the participant's own equipment

was used for the demonstration. However there were several instances when the subjects later had to use different equipment and software. This change in equipment was enough to discourage several participants when they encountered technical or operational difficulties which they were unable to solve on their own.

An assumption made at the outset of the study was that basic instruction and documentation, along with a short demonstration of the various commands, would be adequate. Many participants ran into a host of unanticipated problems because at each of the 16 institutions, the terminal hardware and communications software combinations were unique.

From the standpoint of organizational support for the study, these two factors: inadequate training and lack of an inexpensive 24-hour help line (using voice communications) for technical support combined to create significant barriers to full participation in electronic-mail or other network activities.

2. RESEARCH

Design

Different methods could have been used to assess user reactions to distributed electronic mail networks. The classic control study is one type. In this type of research, hypotheses are formulated a priori and proof is established by a process involving the selection and measurement of variables under control conditions, that is, subjects are compared for a set number and kind of reaction or behavior over a set period of time. Results would be quantitative, and could be statistically analyzed to prove or disprove the hypotheses.

Another kind of study could have been conducted by using more qualitative tools, such as detailed, in-depth interviews, observations, descriptions, and other non-quantitative methods for collecting information over a period of time. Results of this type of study could lead to the development of the classic case study.

Both qualitative and quantitative methods for collecting and analyzing results characterized this study (note the data collection procedures mentioned below). The inquiry was not focussed on particular, narrowly defined questions, but sought to address broad questions. A wide range of information was gathered. Some of the emergent information led to very specific results; some yielded more general results.

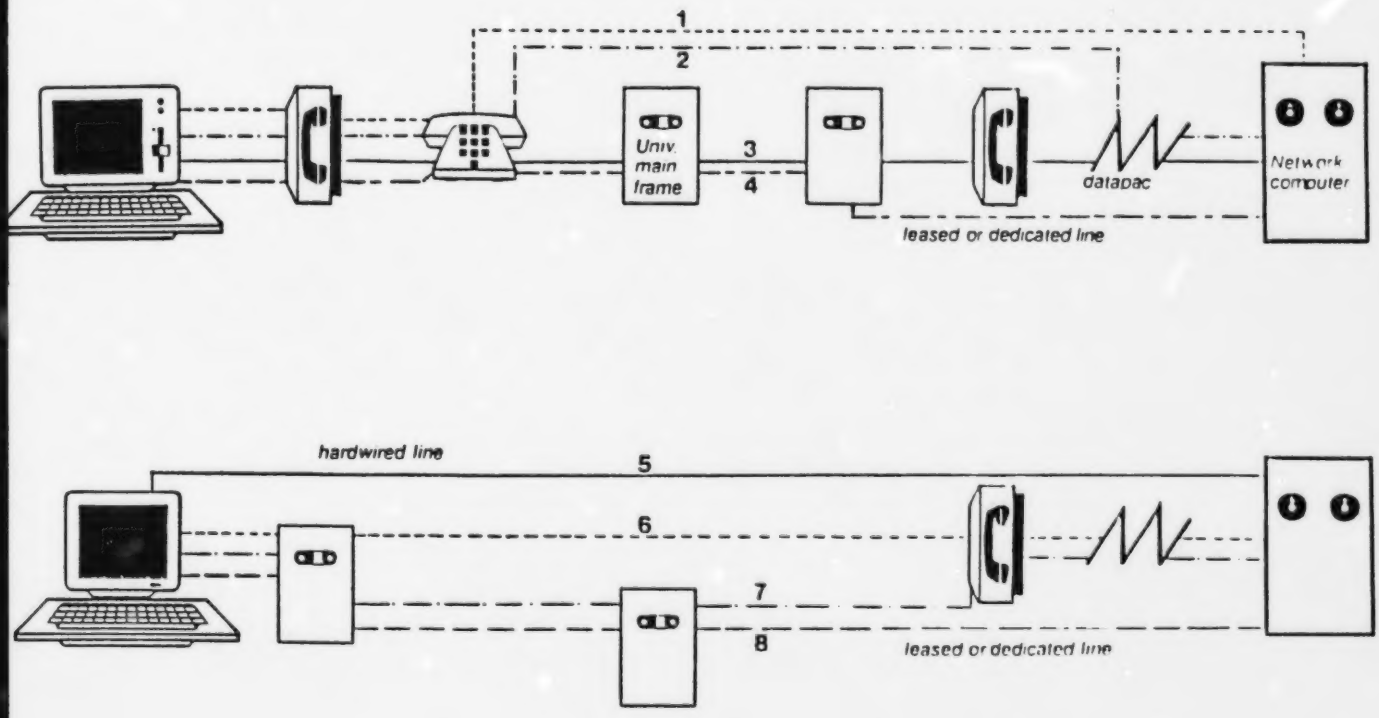
The design chosen has been used previously in new technology research (Picot, 1985) and in evaluation research (Guba and Lincoln, 1983) within a theoretical framework called "grounded theory" which relies on emergent data from the "ground" of the research. Though the inquiry may be bound in time, in space, and by the general questions posed a priori, the procedures used for the collection of data can lead to unexpected results. Quantitative and qualitative information is compared and grouped, later categorized for analysis, leading to the development of new directions for research.

It was considered desirable that the study be conducted under "real world" conditions, to simulate the network situation which would continue to exist for some time after the end of the study. Participants were expected to use available and existing computer resources in their individual institutions.

This meant that each of the study participants used a unique route (for example, dial-up Datapac access) and a unique combination of terminal hardware and software packages for communications, and text processing (see schematic on page 10). Only a small number of factors were common to everyone on each network. One of these was the electronic-mail software on the mainframe computers hosting the gateway at UNB and at Memorial University. At UNB, all the participants would have to access "Mercury," the electronic-mail package that would permit access to a "Mailer" for inter-institutional electronic mail using Netnorth. While it is true that there is no uniformity in the mailers used by Netnorth institutions, there was uniformity as far as this study was concerned. At Memorial University all the users accessed CDNnet through the EAN software.

As it was not possible to predict exactly what combinations would be available to the participants ahead of time, the research design chosen was ideally suited to capturing information as it emerged during the study, and for recording unexpected results.

The schematic shows eight different possible ways that participants could have connected into the network computers. Each step involved a different combination of operating systems and software for each user. This schematic does not take into account the people who were connected to Local Area Networks (LANs), nor does it indicate the sometimes long and complicated route that a message might take to travel between networks. It is clear that an increase in the number of intermediatary steps which are required to access the network increases the chances of having a problem.



Different Network Access Possibilities

Data Collection

Two kinds of data were collected: quantitative data that measured the behavior of a user on the networks, and user impressions towards using the networks.

Computer-monitored data were collected daily, with the participants' knowledge, at the two major nodes. The connect and disconnect times, the network domain and subdomain addresses, and the number of characters sent and received were all noted. This was considered to be the minimum amount of quantitative data to be collected. (Penniman and Dominick, 1980; Rice and Borgman, 1983) A programme was written which captured the same information from the two different computer systems at the two network nodes. It was important that the information collected meant the same thing to enable consistent comparisons between users on both networks. The data was collected from March 2 to September 31, 1986; a 31-week period.

The computer-monitored data provided information about the amount and time of use. However, it was not possible to collect information on attempted log-ins which failed, the specific commands used by participants (that is, compose, read, etc.), nor on messages which never reached their destinations due to incorrect addresses or other reasons. Studies that have collected this type of more detailed information have normally been conducted using only one mainframe computer.

Except for responses provided by participants, the data did not tell us why someone was using the network nor whether they were successful in using the network. For example, electronic-mail might have been used to contact people who are already known to the participant or to contact new people. Electronic-mail could have been used frivolously, or as part of an ongoing communication pattern. Without looking at the content, it was impossible to determine the purpose of the network use, except through participant answers to questionnaires.

Both of the networks in the study were used to transmit the computer-monitored data from each of the mainframes at each network node to CWARC in Laval, where the researcher was located. The data could only be collected when a participant logged into the messaging software programs, that is, Mercury at UNB and EAN at MUN.

A pre-use questionnaire was produced on-line on both networks as well as mailed to each participant at the beginning of March. The questionnaire was designed to obtain the following kinds of information: participant characteristics such as socio-demographic data; participant information regarding production, retrieval and dissemination tasks; and participants' computer literacy skills. The majority of the questions were drawn from studies by S. R. Hiltz (1984). The attitudinal questions were drawn from Dudley & Tombaugh (1985). Finally, some of the task-related questions were borrowed from C. Steinfield (1985). Since almost all of the questions were drawn from previous experiments, the questionnaire was not pre-tested for the present study. A total of 52 questionnaires were returned out of a sample of 61 participants. Only one person responded electronically.

A series of on-line questionnaires was sent to all the participants once it was felt that the majority of participants were capable of using the network. It was thought that the on-line questions would serve a double function of both collecting user perception as they used the networks and also providing some encouragement for users who perhaps had little or no mail. On-line questions were sent May 23; June 12, 20, 26; July 4, 14, 21; and August 26. The response rate was such that 27 different participants answered one or more of these questions. All of the replies were returned electronically.

After the data collection period had ended, a post-use questionnaire was administered. It addressed similar questions and topics as the pre-use questionnaire.

All participants were contacted to determine their availability for interviews. Open-ended post-use interviews were conducted in-person with 31 subjects, with the technical support or "help" contacts at each network node, and with members of the steering committee. These interviews were conducted by the researcher between October 27 to November 5, with available participants in Halifax, Fredericton, Charlottetown and St. John's.

Data Analysis

Since there were multiple sources of data, a variety of different relationships were examined. Coding, tabulation and analyses were done using a microcomputer-based statistical analysis software package called "Powerstat." This software package was chosen because it was immediately available for use on a microcomputer. Originally it was hoped that the researcher might use the SPSS statistical package at a Montreal University. However, network arrangements were not yet in place, and CWARC did not have its own statistical package at the beginning of the study, so it was decided to use "Powerstat." Frequencies, means and totals, within and between networks, for individuals and the systems as a whole, were calculated in the appropriate manner. It was found that "Powerstat" was not entirely suitable for analyzing the amount of computer-monitored data which was collected.

The pre-use, post-use and on-line questionnaires were coded, tabulated and analyzed, individually and comparatively, using the same statistical package as above. Crosstabs, correlations and T-tests were used to determine the shifts, if any, in the participants' perceptions and attitudes from the pre- to the post-use period. Also, the questionnaire results were analyzed in relation to the computer-monitored data.

Since the data sets were all of varying length, it was necessary to make comparisons between data sets of the same size and with the same participants. Thus, the fundamental comparisons were made using a group of 27 participants who answered both the pre-use and post-use questionnaires and who had some computer-monitored data.

3. FINDINGS

The full version of the report contains all the relevant statistics presented in several tables, with summaries of the questionnaire responses and a discussion for each of the subsections listed below.

Expected and Actual Use of the Networks

One of the principal preoccupations of the study from the beginning was whether or not researchers and administrators from a variety of faculties and departments in post-secondary institutions would actually use distributed mail networks. Information on use was obtained by asking study participants for their own perceptions by means of pre-use, on-line and post-use questionnaires. "Actual use" was then measured by collecting computer-monitored data. This gave an account of how often and how much time participants spent on the network. Using this computer-monitored data, it was possible to look at use patterns over the entire study period.

Exactly what relationship exists between amounts of network use and the degree of usefulness is not established, though it was felt that, once the study participants had obtained access to networks, they would only continue, or increase network use if they perceived this activity to be of some value.[1]

Volume was measured by looking at the number of messages sent and received, the amount of time on the networks, the number of log-ins and the average number of log-ins per person per week. These figures show that Netnorth users were more active (by nearly 65 percent as much) than CDNnet users in terms of the number of messages sent and received, but spent far less time per participant on the network. When asked how much time they expected to spend on the networks at the beginning of the study, less than 40 percent thought that they would spend 30 minutes or less per week on the network. At the end of the study, 57 percent of the participants reported spending 30 minutes or less on a network. A comparison between expected use shows a greater difference for Netnorth users than for CDNnet users.

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[1] The network's value to the participant could be more social than work related, but, for purposes of this discussion, the distinction between levels of usefulness will not be drawn.

Looking at these figures for the somewhat limited period of the study only provides one indication of probable behavior by long-term users. Nonetheless, looking at some of the other use aspects that were assessed through this study, the reasons for the different patterns on the two networks could be due to the fact that there are fewer subscribers on CDNnet than on Netnorth. As well, participants for the most part did not have enough information regarding how to use the network to reach people on other networks, and many could not use the directories. Hence, they had to rely on their own contacts and it is unlikely their peers would be on CDNnet as this network is newly established and currently comprises more computer science faculty than other faculty members.

Similarly, looking at the task performances, all users were more optimistic at the outset of the study than at the end. It is likely that in the course of the study their expectations were adjusted by the reality of using the network, from "what could be" to "what is possible".

Much of the data is based on participants' impression of network use and usefulness though it is recognized that for every one of the participants, the measure of what is useful and what is not useful might vary considerably. Even though there is no question that the impressionistic data is supported by those statistics which were gathered by unobtrusive means, the imformation must still be interpreted with caution.

In the course of the study, more and more factors became associated with use and non-use. These ranged from physical problems with access to equipment, or lack of adequate training, to the unavailability of online support when technical problems arose.

Amount of use and perceived usefulness were considered together. Il was felt that if the network is not used, the participant would not be able to judge its usefulness. On the other hand, if there is a growth pattern in use, it can be assumed that for at least some partidipants, it has been "useful" to use a network. The use factor can be assessed by quantitative measures, such as the number of messages, the length of time on the network, the number of tasks performed, and so on. The other factor, usefulness, has been assessed in a qualitative way in this study, that is, by questionnaire and personal interviews with the participants.

Another set of factors must be considered when interpreting the results. It is possible that not all network use was successful. Indeed, accessing often or staying on the network for a long period of time could be an indicator that the user was having difficulty using the system, could not find the service needed,

or was spending time to learn. There was no way to collect information on failed transactions.

Finally, one would have expected that, at least at the at the beginning of the study, participants would have been sending more messages than receiving them. They would have been trying to contact colleagues, obtain distribution lists, query a directory service, or request help. This is true to the extent that both Netnorth and CDNnet users sent more messages during peak periods. Yet for most of the study period, more messages were received than were sent by the participants. One explanation is that several heavy users of distribution lists have skewed the data, though relatively few participants reported using distribution lists on either network.

Barriers to Network Use

In the course of the study, it was realized that a number of participants had decreased, or at least not increased in any significant way, their network utilization. Previous studies have shown that there are a number of factors which create practical, perceived or real barriers to computer-mediated communications, as perceived by potential and actual users (Rice, 1983).

Of all the barriers identified by the participants, the one most often repeated is that associated with the inability to reach specific people electronically. For some, this problem became one of finding or using directories for the correct addresses; for others, especially those on CDNnet, the problem was one of trying to locate people who were on other networks, since CDNnet is but a very small network. Over time, other barriers shifted and lost or gained in importance, but this one did not diminish. **Therefore it must be concluded that for network use to be viable, users must be able to find the people with whom they wish to communicate. Without this, network use will not grow to the critical mass needed for cost-effective and practical utility.**

Since the barriers associated with "not finding the person(s) you would like to reach" became a recurring theme throughout the study, it is important to explore more fully the dimensions of this problem. There may be a fundamental conceptual basis to the problem : for example, participants may have hoped to use the network as a telephone system. Their expectations, in this case, could be that a message can be transmitted to someone at a certain location and that somewhere between origination and destination, the exact address could be obtained. In the telephone system this is done by consulting a hard copy directory, or by asking an operator. However, networks, whether large or small, operate more like postal systems. The user has to know on which machine (analogous to the main post office) the central directory is found (if there is one) and be able to address the directory with the the appropriate command sequence. Alternatively, the user must

know on which network, on which machine and at which site the intended recipient of the message has an account. The sender must have the exact address, including the name (sometimes an alias), the site and machine (the node), and the network for example, CDN, Bitnet, Arpanet, etc.). In this last instance, the sender also has to be aware that most networks are accessible from any one network by crossing "domains"through a "gateway".

In the course of the study, the participants experienced difficulties due to hardware (for example, motems), to software (for example, editors), or to the lack of time needed to become proficient at using the networks. How much these factors contributed to the participants' self-reported negative attitudes towards the use of the networks is uncertain. Still, the participants began the study on an optimistic note, since, when the first contact was made most were eager to use networks, and all, at that time, had some purpose in mind. One can only conclude that small barriers, taken together or in combination with the larger barrier mentioned above were enough to discourage increase in use or even on-going use at the same level by some. One can speculate that if the technical problems or the practical skill needs of the participants had been addressed, as they arose, participants would have overcome their frustrations and, other factors remaining equal, would probably not have lowered their level of use.

Some participants persisted and overcame their difficulties. Some who were already proficient at using computers wished to access networks to find those extra services which their own computers id not offer. Here again, some were disappointed.

By the end of the study, several more factors which would limit use appeared to stand out. The Netnorth participants indicated a reduce concern with the fact that their contacts were not on a network. The Netnorth/Bitnet/Earn network is large, and most of the computers connected to this network are the main university mainframes. CDNnet hosts are not as often situated on mainframes with easy access to the campus community. The Netnorth users did indicate a greater concern with how cumbersome the system is to learn and use. This reflects difficulties with the local electronic-mail program at the UNB site, and should not be generalized to all Netnorth sites because each node operates using different software.

The participants would no doubt have used the networks more had they found readiling accessible those services which they perceived they needed to communicate effectively by electronic means. Though the information could have been provided with the training, or as information kits distributed when the study began, or even in an on-line computer-based help package, probably the most effective way of providing information when needed would have been a 24-hour voice service, such as is provided by

Telcom Canada for Envoy 100 users. To provide such a service would have required a larger investment in the study's technical support aspect. This factor must be taken into account when considering the possibilities for future enlarged network use.

An undercurrent found in responses to questions and discussions with participants is that they would like to be connected with the other researchers or administrators in their immediate field of specialization. It appears that it is this desire which is fueling so much of the interest in "networking" and the desire of many groups to be linke electronically. This has been noted by other researchers and weiters in the field (Sheehan, 1986; Bankier, 1985).

Motivators to Network Use

One of the many reasons that has been given to promote the establishment and use of networks has also been that they increase the speed of communications, and in some way this translated itself into greater efficiency an positive changes in work patterns.These changes are also due to substitutions : that is, using the network substitutes for another, presumabley less efficient or more expensive, means of carrying out the same task.

Thus, overcoming barriers is only part of the problem. There must also be some motivation to keep the users interested and encourage them to overcome the difficulties and achieve proficiency. The use of electronic networking to replace or enhance workplace functions was considered a motivating factor since the desired changes might alter certain workplace activities and improve the users' efficiency. Since networking is supposed to improve one's connectedness with individuals and groups in other locations, it was also expected that participants would communicate with their colleagues.

Comparing the responses to the pre and post-use questionnaires indicates that participants thought that the network would substitute for some of the tasks listed. It is consistent with other responses that use of the network did not produce the anticipated results, in the participants' own opinions. Is this because they hoped for more changes in their work patterns? Or is this because the networks did not deliver the services which they wanted to obtain? Whatever the answer, it would seem that the potential network users must be well informed about network capabilities, and that network access must not be "oversold", otherwise users will soon revert to old, maybe inefficient work habits. The fact that some participants wanted computer conferencing functions, access to remote databases, or specialized software indicates that they were not adequately informed about what the network's capabilities are both in a technical but also a conceptual sense. Since the networks were not able to deliver the hoped-for services in some cases, there is the danger that these same services, even if introduced later,

would not become known to the "disenchanted" users, who will have already become disinterested in network use.

The motivation to use the network is associated with ease of use and with a list of what access to the network will obtain for the user. This wish list should not be dismissed, but rather carefully examined if network managers and designers want to increase the number of users and the level of utilization. In spite of the study's short time frame, it is still safe to state that with increasing numbers of users and services on networks, more tasks will be successfully carried out using network technology to access services available only on distant computers. Some of these services already exist on one or both of the networks. But some participants did not know that certain features existed or did not know how to operate them. This may have been because they lacked the clear documentation that would let them learn more advanced techniques as they used the network.

Network Use and Work Habits

Participants were not depending on electronic mail enough to warrant regular checks. At least one participant specifically wanted to communicate with his home office while in the field, with the possibility of submitting data files into his mainframe account for later analysis. However, from the post-use interviews with those participants who were successfully using the network for some work activities, there is a general feeling that their network use was only just beginning. The majority of the participants stated that they would keep their current network account or get another one at their university. The preference was to get an account on their own university's computer.

It was expected that participants would use the network to co-author publications with colleagues in other locations. It does not appear that this happened very often, however it is evident from the post-use interviews that many participants still expected to be doing this once they were able to successfully contact fellow authors or had more time on the network. The data suggest that during the time of the study, the use of the network did not change the quality or quantity of the participants' work habits. This is similar to the overall use of the network in terms of work habits. **Thus, it is possible that the duration of the study did not allow participants to both get comfortable and also creative in their use of the networks.**

In post-study interviews, participants indicated that although perhaps not entirely successful during the period of the study, they were nevertheless still committed to using the network for certain tasks. Despite their limited use of the network, the desire to communicate by means of networks is strong. As users'

network experience matures they may gradually engage in a variety of network applications, from their offices and from their homes, and while away from home and office.

Network Use and Peer Interactions

A compelling argument favoring the implementation of inter-institutional networks has been the need to compensate for the relative isolation of the faculty member, the researcher, or the administrator working alone is his/her chosen discipline geographically distant from peers, colleagues and co-workers who are engaged in similar research or tasks.

The participants were chosen on the basis of their membership in various organizations and their expressed need to communicate with someone else. It would seem, though, from the responses to this series of questions, that the strength of any academic, peer, or collegial relationship is based on shared research or administrative interests and not solely because one is a member of an association. There was no significant differences between the pre-use and the post-use responses regarding whether or not participants would contact other colleagues, research associates or association members. It could have been expected that a higher percentage of participants would state they were planning to make such contacts. As it was, only 55 percent of the participants' stated in the pre-use questionnaire responses that they planned to contact other groups or individuals. This lower than expected figure either means that some participants had little or no desire to use the network, but wanted to experiment with a new technology. Perhaps there were other reasons why participants answered that they would not and, in fact, did not contact other groups or individuals. The two most frequently stated reasons for not making contact were that the other person is not on a network or the participant has nothing to communicate. The ability to contact colleagues in different locations was hampered by the unavailability of fellow researchers' electronic mail addresses.

Though there is very little information presented in the questionnaire which attests to the number of times study participants tried to get in touch with others and were unsuccessful, there is ample comment from the participants regarding the difficulties encountered in trying to find colleagues on the networks.

The computer-monitored data suggests that most of the communications were regional and then national in character. Perhaps over time, network users will be more adept at first finding and then communicating with colleagues on other networks, a procedure which requires crossing network domains. In order to accomplish these transactions, users must have a clear notion of

what the various aspects of the electronic address imply. In all cases such addresses require absolute accuracy.

Participants' Use of Features

On-line questions asked the participants how often they used on-line editors, while their interview comments shed some light on what they thought about using these editors. On-line questions and interviews were also used to determine whether or not participants used directories to find their colleagues.

These questions may have been confusing to some participants because of a general conceptual weakness in distinguishing between terminal or microcomputer functions and network computer functions (that is, the Memorial or UNB mainframes).

Respondents stated that most of the time, they entered text without using on-line editors. The question was intended to see how many people do not use on-line editors when entering text. From the post-use interviews it seems that most people disliked using on-line editors on both networks. They preferred to upload files that were already prepared in a word processing program. It was not surprising, then, that participants' wish list for desired changes included knowing how to upload or download files into the network. Ten out of 22 respondents usually used their own local editors, then uploaded their files into the network. The people who did not do this presumably entered their text while on-line. There were users of on-line editors who were probably very frustrated by typing errors which could not be easily corrected. For people with microcomputers, it was reported in the interviews that it was easier to correct a mistake in sending a file by simply re-sending the same file.

During the participant selection process, subjects were advised that they should contact their colleagues by telephone or mail to find out if their contacts were on a network and if so, to determine their address. The results of the on-line questions show that participants sometimes used the postal service, the telephone, third-party contacts and directory services. No one way of contacting people dominated.

Participants expected that there would be or should have been directories of who is available on each network in their discipline, much the same as the yellow pages' list different types of business or interest areas. A telephone system model seems to be the underlying assumption of participants' criticism of the lack of directories.

When it came to obtaining help, very few of the 61 original participants sought help from either their university computing centre, the network help contacts, from their colleagues, the AAU staff or from the researcher. If all participants had shown an

active use of the network, then there would be no doubt that they did not need help. However, the reverse was true. From the post-use interviews it was clear that some people were sofrustrated or confused that they did not know what questions to ask. For at least one participant the cost of a long-distance telephone call was a disincentive to seeking help. One participant reported success because she telephoned the network help contact while she was connected to the network. She was then able to type in the suggested commands and see the results immediately.

Cost of Network Use

Participants' Willingness to Pay

It was clear from responses obtained that participants do not want to pay for the use of the networks at this time. Furthermore, they do not seem to have any idea of the cost to their institutions for network services. It should also be noted that study participants probably do not pay for long-distance calls from their offices either, and so are unaware or not directly affected by the fact that there might be significant cost savings in electronic mail as opposed to long-distance telephone calls.

Estimated Cost of Network Use

One limitation of this study is that it does not make precise comparisons of network costs. This is because an accounting package already in existence at the UNB gateway provided the administrators of the study with precise information on the costs of network utilization by each of the study participants. At Memorial, no such accounting package was available, as EAN is not equipped to provide detailed cost breakdowns at this time. However, some costs comparisons can be made, on the basis of the overall costs of using the two networks over the entire period of the study. Secondly, since the Netnorth/Bitnet network mostly uses dedicated lines, it is possible to compare these charges against the charges of establishing a dial-up network, as was done for the CDNnet node at Memorial.

The implementation of Netnorth using leased lines to connect nodes and sites makes this network sufficiently costly that further implementation of linkages requires attention be paid to the question, "how many users will use the networks and for what purpose." On the other hand, the implementation of the CDNnet with the x.400 software (EAN) does not require leased lines, as explained earlier.

A comparison of the costs of using these two networks and three others has been provided by Michael Rayment in a recent unpublished article titled "Electronic Mail and What it Can Do for You."

Cost breakdown for Network Usage

	1 User					100 Users				
	1	2	3	4 in $	Total	1	2	3	4 in $	Total
Network										
uucp	75	0	0	25	104	99	0	0	1	7831
ean	1	0	0	99	194	53	0	0	47	405
bitnet	0	0	0	100	1756	0	0	0	100	1756
envoy100	42	0	45	13	203	47	0	51	2	18320
iNet2000	0	85	14	1	528	0	85	14	1	52800
Can.Post	100	0	0	0	68	100	0	0	0	6800

*Except where indicated figures are a pourcentage.

Source: Rayment, M. - "Electronic Mail and What It Can Do for You." M.U.N., 1986.

The table above represents the approximate costs to send a letter/message to Vancouver assuming prime-time rates. The percentages in the table represent the relative contribution of the four factors listed below in calculating the final costs.

*

1) Cost for 100 messages received and 100 messages sent where each message averages 1/2 kilobyte in size (about 1/2 of a typewritten page).

2) Connect charges for 30 hours/month or 1 hour/day of usage for the messaging services.

3) Cost of 1.2 megabyte of mail stored on disk.

4) Basic monthly charge for service, regardless of usage.

The table assumes costs of CDNnet and Netnorth are attributable to a basic monthly service charge. The Netnorth figure represents the cost of a leased line from Memorial to the UNB node. This figure varies between each Netnorth node which uses leased lines. The CDNnet cost represents the cost of a datapac connection. All figures were calculated assuming that messages would be sent immediately, therefore prime-time rates were used for calculations (Rayment, 1986).

The EAN software is much cheaper to implement, and with time, will be available on microcomputers so that even users remote from nodes will be able to access networks from their homes, download the services and the information they need, and upload files easily. However, it is unlikely CDNnet will be able to continue to exist by itself, as the network does not have a quantity of users and sites sufficient to reach a critical mass.

4. CONCLUSIONS AND RECOMMENDATIONS

The study was undertaken under similar conditions to those which would, at least in the short- to mid-term, characterize the conditions under which network users would work. For some, access would be first by a microcomputer of their choice. For others, access would be from terminals and microcomputers directly connected to the mainframes. For still others, they might use a network on their own university's mainframe as an entry to the desired network. Whatever the combination, a certain basic conceptual understanding of the process is needed. Though technical details are not essential, an intelligent use of the various functions is basic to optimum network use. Without a basic understanding of some of the concepts involved, and without some of the skills needed to use the networks successfully, it is unlikely that the number of users will grow substantially. Furthermore, without growth in the number of users and user groups it is unlikely most users will continue networking as they will not be able to contact their peers on a network.

The reasons the study participants were likely to want to use networks were judged to be typical, but not enough attention was given to the selection process. It was thought that peer networking would be an adequate reason for communication (as evidenced through membership in an association). It is likely that a more specific focus for communications is needed, such as a project, an agenda, a research interest, a specific task, or a question to discuss.

As networks were used successfully during the entire study by the researchers and by the study participants as well, their viability is not in question. What the study shows is that certain features and services are required before optimum use can be made of the networks by the average user in the academic environment.

The successful operation of a network requires that a critical mass of users can be reached on inter-institutional networks. In order for a large enough group of users to first, access, and then, continue using networks, three sets of conditions are required:

1. assistance to users, including training,
2. network and electronic mail services,
3. user interface features.

These conditions must be implemented and maintained by a combination of computer centre managers and network providers, managers or designers. Alternatively, some of the services could be provided by an intermediary agent, such as a help or information centre or center of operations maintained by the network.

The first level - assistance to users - should include hands-on demonstrations and training for neophytes as well as experienced computer users. Such training must embody sound pedagogical principles to allow the learner to achieve a conceptual understanding of the basics of network communications, and realize some early successes in networking. The training must be partly self-paced, to allow more experienced users to only learn those aspects not already familiar to them. The conceptual basis for the training must differentiate between various levels of hardware and software needed to access a network and send messages. A pedagogically sound training package needs to be developed which would be partly "generic" so that it is applicable to the many different hardware and software combinations likely to be encountered. As well, the package needs to be adaptable to specific network access situations.

Following hands-on training, on-line help by telephone should be available, along with tutorial information on-line. Depending on the number of users and their work habits, the time zones and the location of the users, the telephone line service may be required over a 24-hour basis.

The second set of required conditions consists of user services needed on the network itself. Although the gateway computer may not house these services, there is a responsibility on the part of the gateway operator and manager to point the way to the services: including network directories, instructions for accessing other networks, and file servers describing a range of services which this study has shown academic users will need. The network must not be oversold: that is, users need to be told what they can obtain on networks, and what is not possible (for example, it is not possible to undertake computer conferencing on a distributed network, at this time). More interest groups, associations, committees, and users with similar interests should provide network addresses in their (hard copy) directories. Individuals should write network addresses on their business cards. Faculty lists should include network addresses. **Only by making these addresses known will using the networks for communications become as commonplace as using the telephone.**

The third set of conditions, called "features," consists of those requirements which local hardware and software resources must make available when the user accesses the system at the first level. These features include simple ways to store mailing lists and easy instructions regarding file transfer from micro-computer to mainframe and vice-versa. As well, the user must be helped to access the gateway as quickly and as transparently as possible. It is recommended that creating such a transparent network environment be the responsibility of the computer centre where the user would have his/her identification.

Without the improvements suggested, network use will not grow. It is equally clear that in planning for network development, particular user reactions at one stage in time are but one of the elements to consider. There is no doubt that factors associated with cost savings, and the improvements which are being implemented due to on-going technological developments must also be given due consideration.

The factors associated with network costs require decision-makers to weigh the relative costs and merits of communicating by electronic mail versus by telephone, especially within Atlantic Canada, for this region has the highest long-distance telephone charges for short distances than anywhere else in Canada. Though the initial startup costs may be high, especially in the light of the (somewhat costly) recommendations regarding training and user assistance, in the long run, this investment will permit institutions to realize important cost-savings. It must be noted, however, that, as far as the user in an academic environment is concerned, because he or she does not usually pay business-related long-distance telephone calls out of his or her own personal funds, there may be little incentive to switch from telephones to the less expensive form of communications, electronic mail.

The factors associated with changes in network development were not made known to the participants during the study and therefore made no impact on them. Two such developments need to be mentioned. One is the increasing number of Netnorth nodes in Atlantic Canada. At the time of writing, there were 8 nodes. At the beginning of the study only UNB and Universit{ de Moncton had Netnorth nodes. The other development is the increasing availability of public datapac ports in Atlantic Canada, making it possible for more widely dispersed communicators to access the datapac network. However, in Atlantic Canada, in spite of increasing datapac access, some users will still have to use long-distance dial-up for access. Since the remote users are the ones most likely to need access to networks, much development is needed in this area.

Far more work needs to be done to realize the universal dream of network users, that is, the creation of an international homogeneous network, which incorporates all of the features which participants identified as desirable. The x.400 standard was developed to work harmoniously with x.25 packet switching networks, but it can also be implemented with local area networks and RSCS-type networks. Currently, the message handling software associated with x.400 contains a user agent (UA) and a message transfer agent (MTA). The UA component is now being designed for implementation in the microcomputer environment and it will permit even remote users to be linked to a nearby mini computer running MTA and enjoy the network's full range of services. In this environment, even the small and remote institutions would be able to provide network access with the full screen features for

a small investment. This study did not examine the technical aspects or the potential of such developments. This is clearly an important area for future research.

The study points to a number of other areas for applied research. More work needs to be done to foster network transparency. The need for directories is important enough to justify a separate research project which might investigate having directories on each network, and perhaps a general directory of all users. This research could involve both the costs of establishing and maintaining these directories as well as the mechanics of doing so on a uniform basis.

While the study did ask questions about the workplace activities of academics and administrators, it was not a study of productivity as such. The study's results did not tell us whether or not a faculty member will do more or better work if he/she is using a network.

The present study was concerned with distributed messaging networks. However, as was seen in many of the participants' comments, there is a need for more information about file servers, distribution and mailing lists. It is not enough to simply collect information about what services exist to serve which groups or individuals. There is a need to rationalize their development and integration with distributed communications networks. Clearly the ideal is to have all these services easily accessible from one location, the user's computer.

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